NUREG/CP-0173

# International Collaborative Project to Evaluate Fire Models for Nuclear Power Plant Applications: Summary of 2nd Meeting

Held at
Institute for Protection and Nuclear Safety
Fontenay-aux-Roses, France

June 19-20, 2000

Hosted by
Institute for Protection and Nuclear Safety
77-83, avenue du General-de-Gaulle - 92140 Clamart
B.P. 6 - 92265 Fontenay-aux-Roses Cedex
France

NUREG/CP-____

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# Abstract

The 2nd meeting of the International Collaborative Project to Evaluate Fire Models for Nuclear Power Plant Applications was hosted by the Institute for Protection and Nuclear Safety (IPSN) and held in the IPSN offices at Fontenay-aux-Roses, France on June 19 and 20, 2000. The Organizing Committee for the meeting included Remy Bertrand from the IPSN (France), and Moni Dey from the U.S. NRC. Eighteen experts from five countries attended this international meeting.

The purpose of the 2nd meeting was mainly to finalize the definition of a benchmark exercise to evaluate zone and computational fluid dynamics (CFD) fire models for application in nuclear power plants. This exercise was identified as the first task of the project and was aimed at evaluating the capability of fire models for simulating cable tray fires of redundant safety trains in nuclear power plants. The discussions at the meeting resulted in three main issues regarding input parameters for the scenarios in the benchmark exercise: (1) specification of the fire source; (2) modeling of the target; and (3) value for the lower oxygen limit. The specification of the fire source is fundamental to the input for fire models, and can significantly affect the predicted thermal environment. A consensus was reached on the characterization of the HRRs for the scenarios in the benchmark exercise. Although agreement was reached on the specification and values for the target model and lower oxygen limit to be used for the benchmark exercise, participants did not reach a consensus on the most appropriate specification that could be recommended for model users. The specification of the above three parameters could lead to “user effects,” and are the largest sources of uncertainty in the predicted results from the input parameter specification process for the types of scenarios examined in the benchmark exercise.

# Acronyms and Initialisms

| | |
|---|---|
| BRE | Building Research Establishment |
| CIB | International Council for Research and Innovation in Building and Construction |
| CFAST | Consolidated Model for Fire and Smoke Transport |
| CFD | Computational Fluid Dynamics |
| COCOSYS | Containment Code System |
| EdF | Electricite de France |
| EPRI | Electric Power Research Institute |
| FDS | Fire Dynamics Simulator |
| GRS | Gesellschaft fuer Anlagen-und Reaktorsicherheit |
| HRR | Heat Release Rate |
| iBMB | Institut fuer Baustoffe, Massivbau und Brandschutz |
| IPSN | Institute for Protection and Nuclear Safety |
| JASMINE | Analysis of Smoke Movement in Enclosures |
| LOL | Lower Oxygen Limit |
| NII | H. M. Nuclear Installations Inspectorate |
| NIST | National Institute of Standards and Technology |
| NPP | Nuclear Power Plant |
| NRC | Nuclear Regulatory Commission |
| PRA | Probabilistic Risk Analysis |
| PWR | Pressurized Water Reactor |
| VTT | Valtion Teknillinen Tutkimuskeskus |
| WPI | Worcester Polytechnic University |

**Table of Contents**

# 1 Introduction

The objective of the International Collaborative Project to Evaluate Fire Models for Nuclear Power Plant Applications is to share the knowledge and resources of various organizations to evaluate and improve the state of the art of fire models for use in nuclear power plant (NPP) fire risk assessment. The project is divided into two phases. The objective of the first phase is to evaluate the capabilities of current state-of-the-art fire models (zone and CFD) for fire risk assessment in NPPs. The second phase will implement beneficial improvements to current fire models that are identified in the first phase, and extend the validation database of those models.

The 1st planning meeting of the project was held at the University of Maryland at College Park, USA, on October 25-26, 1999. The summary of the 1st meeting and the details of the objectives established for the project can be found in NUREG/CP-0170 (April 2000). The 2nd meeting of the collaborative project was hosted by the Institute for Protection and Nuclear Safety (IPSN) and held at the IPSN offices at Fontenay-aux-Roses, France on June 19 and 20, 2000. The organizing committee for the 2nd meeting included Remy Bertrand from the IPSN (France), and Moni Dey from the U.S. NRC. The experts attending the meeting were:

1. Marina ROEWEKAMP, GRS, Germany
2. Bernd SCHWINGES, GRS, Germany
3. Juergen WILL, iBMB, of Braunschweig Tech. Univ., Germany
4. Olavi KESKI-RAHKONEN, VTT, Finland
5. Stewart MILES, BRE, UK
6. Peter REW, W S Atkins, UK
7. Moni DEY, NRC, USA
8. Jonathan BARNETT, WPI, USA
9. Jean-Pierre SURSOCK, EPRI, USA
10. Maurice KAERCHER, EDF, France
11. Bernard GAUTIER, EDF, France
12. Olivier PAGES, EDF, France

13. Joel KRUPPA, CTICM, France

14. Remy BERTRAND, IPSN, France

15. Jean-Marc SUCH, IPSN, France

16. Chantal, CASSELMAN, IPSN, France

17. Jocelyne LACOUE, IPSN, France

18. Alberto ALVAREZ, IPSN, France

The following organizations sponsored or collaborated with the organizations directly represented at the meeting:

1. H. M. Nuclear Installations Inspectorate, UK
2. Industry Management Committee, UK
3. National Institute of Standards and Technology, USA

The purpose of the 2nd meeting was mainly to finalize the definition of a benchmark exercise to evaluate capabilities of current zone and CFD models. This exercise was identified as the first task of the collaborative project and was aimed at evaluating the capability of fire models for simulating cable tray fires of redundant safety trains. A definition of the problem for the benchmark exercise had been proposed prior to the meeting, and this served as the starting point for comments and discussions at the meeting. This definition is included in Attachment A. The objective, background, and procedure proposed for the exercise is presented in the next section.

The agenda of the 2nd meeting included the following objectives:

- Present proposals and comments for the benchmark exercise, including a description of the fire models participants intended to use in the benchmark exercise;
- Finalize the formulation of the benchmark exercise, and plan the milestones and a schedule for the completion of analyses for the benchmark exercise;
- Formulate future tasks, including opportunities for collaborative experimental research for fire modeling development and validation; and
- Present tasks conducted in national programs for fire modeling (e.g., test results pertinent to the issue under examination).

The full agenda of the 2nd meeting is included in Attachment B.

# 2 Background

The objective, background, and procedure proposed for the benchmark exercise that was the main subject for the 2nd collaborative project meeting is presented below.

The benchmark exercise was developed to evaluate the capability of fire modeling analyses to provide results for a probabilistic risk analysis (PRA). In a PRA study, fire models are used to estimate the conditional probability of safe-shutdown equipment damage given a postulated fire. The main fire protection features that effect the development of a fire are:

8. Automatic fire detection (detection by operators is also important).
9. Automatic or manual isolation of the fire rooms by the closure of fire doors and dampers.
10. Fire suppression (automatic and manual) with gaseous suppression systems (Halon or $CO_2$), and nongaseous water-based suppression (sprinkler) systems.

In a PRA study, the target damage time is compared with the duration of a specific fire scenario identified in an event tree formulated to model the possible combinations of the above events. The conditional probability of the safe shutdown equipment damage is the probability of that fire scenario, if the damage time is less than the duration of the fire scenario.

Given the state of the art of fire modeling, the adequacy of fire detection and suppression is normally not included in fire modeling analyses to support a PRA. Therefore, the benchmark exercise proposed did not include the evaluation of these systems or events.

The benchmark exercise is intended to be for a simple fire scenario for a NPP defined in sufficient detail to allow evaluation of the physics modeled in the fire computer codes. This approach is similar to that adopted by the CIB W14 effort for fire code assessment. An assessment of appropriate input parameters and assumptions, interpretation of results, and determining the adequacy of the physical models in the codes for specific scenarios will establish useful technical information regarding the capabilities and limitations of the codes. This valuable information will be documented in a technical reference manual for NPP fire model users. Generic insights regarding the capabilities of the models will also be developed in this process and documented in the final technical reference guide.

The comparisons between fire codes can be used to understand the modeling of the physics in them, i.e., if all the codes produce similar results over a range of fire scenarios then the physics modeled in the codes is probably adequate for the proposed scenario. However, the compounding effects of different phenomena will also need to be evaluated. Some variations in the results may be acceptable depending on how the results will be used. Uncertainties in the predictions of the fire models based on validations of each fire code will be discussed and provide a basis for the confidence on the set of results developed in the proposed benchmark exercise.

The following procedure was proposed to be adopted for the benchmark exercise:

1. Analysts should discuss and agree on the input data for the various fire codes that will be used in the benchmark exercise. The goal is for participants to analyze the same problem and minimize the variation of results due to differing input data. User effects will be examined at a later stage.
2. The form of the results to be compared should be agreed upon by participants prior to the commencement of the exercise.
3. Developers of the fire codes, and those not involved in the development of the codes, can conduct the code analyses for the benchmark exercise.
4. Blind simulations will be conducted, i.e., each analyst will independently conduct his or her analyses. The results will be shared between participants when all the analyses by participants have been completed and results are available. The results will be simultaneously posted on the collaborative project web portal prior to a meeting of the participants.
5. If desired, the same code (e.g., CFAST) can be used by different organizations since this will provide useful information on whether the results vary with different users. However, the same version of the code should be used (for CFAST, use Version 3.1.6).
6. A series of benchmark exercises will be defined and conducted in this project. This will allow the evaluation of the full spectrum of fire model features and applications, and facilitate formulation of a comprehensive technical reference for users on the capabilities and limitations of the current state-of-the-art fire models.

The details of the postulated fire scenarios and data proposed to be used in the benchmark exercise is included in Attachment A. In summary, the simulation of fires inside a representative Pressurized Water Reactor (PWR) emergency switchgear room was selected for the benchmark exercise. This room contains electrical cables associated with safe shutdown equipment of two redundant trains which are separated horizontally by a distance, D. The value of D is varied in the fire simulations.
The postulated ignition source is a transient combustible fire that ignites cables. Several configurations of the compartment ventilation conditions are to be analyzed with the mechanical or forced ventilation system on or off, and the compartment door open or closed.

# 3 Meeting Summary

## 3.1 Session 1: Comments on Benchmark Exercise, and Description of Fire Codes

In the 1st session, participants provided comments on the proposed definition of the benchmark exercise. Participants also presented a description of the models that they intended to use for the exercise. The view graphs used for the presentations are included in Attachment C. The codes participants proposed to use in the benchmark exercise were:

1. COCOSYS, CFX - *GRS*
2. CFAST - *IBMB/GRS*
3. JASMINE, CFAST - *BRE/NII*
4. FLAMME-S, *IPSN*
5. MAGIC, *EdF*
6. CFAST, FDS - *NRC/NIST*

The major remarks related to the definition of the benchmark exercise that were made by participants and recorded (on a flip chart) at the session are presented below in Section 3.2.

## 3.2 Session 2: Finalization of Benchmark Exercise

The following comments on the benchmark exercise were discussed and resolutions developed at the meeting. As proposed in the procedure for the benchmark exercise, efforts were made by the participants to arrive at a consensus on values for all input parameters needed for the various codes to be used in the exercise. Following a summary of the main issues regarding input parameters for the scenarios in the exercise, the discussion at the meeting is presented in the format of issues raised, and the disposition of the issues agreed to by the participants.

<u>Summary</u>

The discussions at the 2nd meeting resulted in three main issues regarding input parameters for the fire scenarios in the benchmark exercise:

A. Specification of the fire source;
B. Modeling of the target in the compartment; and
C. Value for the lower oxygen limit (LOL).

The specification of the fire source is fundamental to the input for fire models, and can significantly affect the predicted compartment thermal environment. A consensus was reached on the characterization of the heat release rate (HRR) for the fire scenarios for the benchmark exercise. Although agreement was reached on the specification and values for the target model and LOL to be used for the benchmark exercise, participants did not reach a consensus on the most appropriate specification that could be recommended for model users. The specification of the above three parameters could lead to "user effects," and are the largest sources of uncertainty in the predicted results from the input parameter specification process for the types of fire scenarios examined in the benchmark exercise. These three issues are summarized below at the beginning of the list of issues.

Main Issues

1. Issue: The HRR curves of cable tray fires should be realistic and based on experiments.

   Disposition: The modeling of and predicting the HRR of a burning cable tray stack is extremely complex, and current models are not capable of realistically predicting such phenomena. Therefore, the HRRs of the burning cable tray stack will be defined as input in the problem. The consecutive ignition and burning of all three cable trays (trays A, C2, and C1) will be modeled as one fire. The analyses will assume peak HRRs for the whole cable tray stack between 1 and 3 MW[1]. A t-squared growth will be assumed with $t_o$ = 600 s, and $Q_o$ = 1 MW[2], where:

   $$\dot{Q} = Q_0 (t / t_0)^2$$

   A fire duration of 60 minutes at peak HRRs will be assumed, followed by a t-squared decay with similar constants as for growth. Experiments conducted by EdF have shown that peak HRRs for cable tray fires generally do not last more than 60 minutes.

2. Issue: The type and dimensions (diameter) of the cables need to be specified in more detail to allow more detailed modeling of heat transfer to the cables. What temperature in the cable should be used to establish the criterion for cable failure or damage?

   Disposition: Simulations should be conducted for power cables (50 mm diameter),

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[1] The 1 – 3 MW range was chosen as bounding values for a stack of 3 cable trays. Considering a heat of combustion of 25 MJ/Kg and a surface controlled specific mass loss rate of about 3 g/m$^2$-sec for cables that pass the IEEE tests, a cable tray 15 m long and 0.6 m wide will have an effective HRR of 0.9 MW. An earlier study (NUREG/CR-4230), and fire tests reported in EPRI NP-2660 and EPRI NP-2751 also concluded that the peak HRR for a cable tray is limited from 0.8 to 2 MW for a well ventilated room.
[2] EdF CNPP tests (1997)

and instrumentation cables (15 mm diameter). For models in which targets are represented as rectangular slabs, the slabs should be assumed to be oriented horizontally with a thickness of 50 mm and 15 mm correspondingly. Some participants expressed concern regarding the adequacy of a one-dimensional target model since the incident radiative flux would vary with the orientation of the slab. Also, the specification of the slab thickness, and selection of the criterion for cable damage (surface temperature versus centerline temperature) would be key to the success of a one-dimensional target model. The cable surface temperature is not indicative of the effects of the thermal environment on cable functionality. IPSN experiments indicate that the temperature of the PVC insulation of the electrical conductors reaches about 200 $^0$C when cable malfunctions occur. Based on experience from experiments conducted at VTT, it was decided that the centerline temperature of a target slab, with a thickness equal to the diameter of the cable, would best approximate the temperature on the inside of the outer cable jacket. However, some participants felt that the slab dimensions specified for the benchmark exercise may be too thick and result in the simulation of a larger thermal inertia of the target than exists in reality.

3. Issue: What value should be used for the LOL for the cases in the benchmark exercise?

   Disposition: At the meeting, it was decided that in order to be conservative a value of zero should be used for the LOL in the base case, and that one case should be evaluated with LOL set at 12% if the model allowed this parameter to be varied. This proposal was put forth based on experimental observations which indicated that it was difficult to determine an LOL value because of the complexity of the combustion phenomena, and effects of ventilation on combustion. Some participants felt that setting LOL at 0 % for cases which were developed to examine the effects of ventilation will be contradictory, and for other cases would not yield best-estimate results. Therefore, it was suggested that the LOL be set at 12% in order to examine these effects.

<u>Other Issues</u>

4. Issue: Should user effects be addressed in this benchmark exercise?

   Disposition: As proposed in the procedure for the benchmark exercise, analysts should discuss and agree on the input data for the various codes that will be used in the benchmark exercise. The goal is for participants to analyze the same problem and minimize the variation of results due to differing input data. User effects will be examined at a later stage.

5. Issue: The mechanical ventilation rate of 9.5 $m^3$/s supply and exhaust of the compartment in the proposed definition is too high. Zone models would not be valid

for such high ventilation rates because there would be significant local effects due ventilation.

Disposition: Typically, nuclear power plant compartments have mechanical ventilation systems with volumetric flow rates of two to five volume changes per hour. It was decided that a constant volumetric flow rate of five volume changes/hour would be used for all the cases in the benchmark exercise.

6. Issue: The content and dimensions (including floor area) of the trash bag fire source should be specified because some plume correlations require the fire area, and the knowledge of the contents is necessary to determine the species yielded in the combustion process.

   Disposition: Assume the contents of the trash bag are: (1) straw and grass cuttings = 1.55 kg; (2) eucalyptus duff = 2.47 kg; and (3) polyethylene bag = 0.04 kg. The contents were thoroughly mixed, and then placed in the bag in a loose manner. Assume the trash bag is a cylinder with a diameter = 0.492 m, and height = 0.615 m[3].

7. Issue: The curve for the HRR of the trash bag fire should be specified so that there are no errors in the heat input to the fire simulation.

   Disposition: Assume a linear fit between the points provided for the fire curve. Specifying the best curve to go through the data points from the experiments may introduce more error than assuming a linear interpolation between the points.

8. Issue: Should corner/wall effects be examined in this benchmark exercise? In practice, cable trays are installed nearer than 0.9 m's from walls as specified in the proposed benchmark exercise. Should transient combustibles in the corner or along walls be considered?

   Disposition: In order to minimize the number of cases for the benchmark exercise, corner/wall effects will not be examined now but at a later stage. However, model users may run additional cases to examine the issue, and present the results to other participants.

9. Issue: What value should be used for the constriction or orifice coefficient for the vents in the simulation?

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[3] Lee, B. T., "Heat Release Rate Characteristics of Some Combustible Fuel Sources in Nuclear Power Plants," NBSIR 85-3195, National Bureau of Standards, 1985; and
Van Volkinburg, D. R. et al, "Toward a Standard Ignition Source," Paper No. 78-64, Lawrence Berkeley Laboratory, University of California, Berkeley, California, 1978

Disposition: Based on expert opinion of the participants, it was decided that a value of 0.68 would be used for the benchmark exercise.

10. Issue: What value should be used for the convective heat transfer coefficient?

    Disposition: Based on expert opinion of the participants, it was decided that the convective heat transfer coefficient would be set value at 15 $Wm^{-2}K^{-1}$ for the benchmark exercise.

11. Issue: Should the structures securing cable trays be evaluated as targets in the problem?

    Disposition: In order to limit the scope of the current benchmark exercise, the fire modeling of cable tray structures will not be included in the analyses. However, model users may include this analysis and share the results with the other participants.

12. Issue: Should the door be open to ambient conditions outside, or to another compartment? In NPPs, doors in most compartments typically open to another compartment.

    Disposition: In order to simplify and make feasible the evaluation of model effects, multi compartment analysis will not be included at this stage since that would include additional considerations and effects on the results. However, modelers may evaluate the effect of this important assumption on the results and share the information with other participants.

13. Issue: Intermediate results other than cable temperature should be presented to allow a full evaluation of results, and for generating statistics of the results.

    Disposition: In addition to the cable centerline temperature, it was decided that the following parameters would be reported in the benchmark exercise:

    a. Upper layer temperature
    b. Lower layer temperature
    c. Depth of the hot gas layer
    d. Heat release rate
    e. Oxygen content (upper and lower layer)
    f. Flow rates through the door and vents
    g. Radiation flux on the target
    h. Target surface temperature
    i. Total heat loss to boundaries
    j. Chemical species (CO, HCL, soot (C)) in the upper layer

For CFD and lumped-parameter models, the profile at the midpoint of the room should be presented.

14. Issue: The physical properties (heat conductivity, density, and specific heat) and the thickness of the fire door are needed.

    Disposition: Assume the fire door is a metal-clad door with a wood core and insulating panels between wood core and metal clad (on both sides of the wood core). Assume the metal clad, wood core, and insulating panels are 0.6, 40, and 3 mm thick respectively.

Properties of Fire Door

| | Thermal Conductivity (W/m°C) | Density (kg/m$^3$) | Specific Heat (kJ/kg °C) |
|---|---|---|---|
| Carbon Steel | 43 | 7801 | 0.473 |
| Yellow Pine | 0.147 | 640 | 2.8 |
| Fiber, insulating panels | 0.048 | 240 | |

15. Issue: The chemical properties of the cables (C, CL, O, and H amounts), the necessary amounts of oxygen, and the yields of CO, $CO_2$, $H_2O$ vapor and soot should be given.

    Disposition: Assume the cable insulation is PVC – polyvinyl chloride. Chemical formula is $C_2H_3Cl$. The oxygen-fuel mass ratio = 1.408. Yields (mass of species/mass of fuel) are $CO_2$ = 0.46, CO = 0.063, HCL = 0.5, soot = 0.172.

16. Issue: The location of the doors and vents are necessary for use in CFD and lumped parameter models.

    Disposition: Assume the door is located at the center of the front wall, and the vents are at the center of the side walls.

17. Issue: Some fire codes require the specification of a large leakage opening (when doors and vents are closed) to prevent numerical instability in the computer model and successful execution of the code (e.g., HARVARD 6).

    Disposition: The leakage value specified in the proposed problem definition should be maintained. Users of codes with the limitation should adjust the value as needed, and document the value used.

## 3.3 Session 3: Fire Modeling Research in National Programs

The 3rd session was dedicated to the presentation of fire modeling research conducted in national programs. The view graphs used for the presentations are included in Attachment D. The presentations included research on:

- fire tests performed to determine the performance of electrical cables
- determining the burning behavior of electrical cables using different experimental methods
- cable tunnel fire experiments
- estimation of the probability distribution of secondary target ignition
- application of fire models to address fire protection issues
- blind simulations using a CFD code
- simulation of turbine-generator fires

Meeting Conclusion

The meeting concluded with discussion of actions participants volunteered to take, and the schedule for the project, future tasks, and meetings. Moni Dey, NRC and Jonathan Barnett, WPI volunteered to develop the first draft of the outline of the technical reference document which would be sent to other participants for comments. It was decided that the results of benchmark exercise would be discussed at the next meeting of the project in January 2001. A draft of the outline of the technical reference document would be developed by March 2001, and the final report issued by December 2001. Regarding the second phase of the project, new experiments for validating fire models will be defined by March 2001. A program for validating fire computer codes with new tests, and implementing improvements to the fire models is planned between October 2001 and September 2004. The NRC indicated its interest in international collaboration in this phase of the project, and suggested the international collaborative efforts for developing severe accident codes as a model. In this program, each country conducted fire tests which were offered for an international standard problem exercise.

Bob Kassawara of EPRI offered to host the 3rd meeting at its offices in Palo Alto, California, USA on January 15 and 16th, 2001 (after United Engineering Foundation meeting on January 7-12, 2001 in San Diego, USA). Marina Roewekamp of GRS offered to host the 4th meeting at its offices in Berlin, Germany on September 24-25, 2001.

The meeting was concluded by Remy Bertrand of IPSN.

# Attachment A: Definition of Standard Problem

# Attachment B: Agenda

**International Collaborative Project to Evaluate
Fire Models for Nuclear Power Plant Applications**

**2nd Meeting**

June 19-20, 2000
Fontenay-aux-Roses, France

*Hosted by the*
**Institute of Protection and Nuclear Safety, France**

June 19, 2000
Room 004, Building 8

Registration: 8:30 - 9:00 a.m.

Welcome: 9:00 a.m.

Remy Bertrand, IPSN

Session 1: 9:15 a.m. - 1:00 p.m., June 19, 2000
Discussion Leader, Moni Dey, NRC

Topic - Presentation of proposals and comments for standard problem exercises, including a description of the models participants intend to use in the exercise. Allotted time for each paper is twenty minutes.

1. NRC Proposal for the Standard Problem Exercises, Moni Dey, NRC

2. Overview of CFAST, Walter Jones, NIST, and Moni Dey, NRC (presented by Moni Dey)

3. IPSN Fire Computer Codes - FLAMME_S Zone and ISIS CFD Models, Chantal Casselman, IPSN

4. Proposals and Comments for Standard Problem Exercises, Jocelyne Lacoue, IPSN

5. Effects of Physical Sub-models and Design Fire in Zone Model Calculations, Dietmar Hosser, G. Blume, and J. Will, iBMB of TU Braunschweig (presented by J. Will)

6. Status of Fire Simulation with the GRS code COCOSYS, Walter Klein-Hessling, and Bernd Schwinges, GRS (presented by Bernd Schwinges)

7. Proposals and Comments for Standard Problem Exercises, Marina Roewekamp, GRS

8. Proposals and Comments for Standard Problem Exercises, Olavi Keski-Rahkonen, VTT

9. Proposals and Comments for Standard Problem Exercises, Other attendees

Session 1: Continued, 2:30 - 5:30 p.m., June 19, 2000

10. Group discussion to formulate the standard problems

Session 2: 9 - 10:30 a.m., June 20, 2000
Discussion Leader, Moni Dey, NRC

Topic - Planning Session

1. Review and finalize formulation of standard problems, All attendees

2. Plan milestones and schedule for completion of analyses for standard problems

3. Formulate future tasks, including tasks for collaborative experimental research for fire model validation and development

4. Plan future meetings

Session 3: 11:00 a.m. - 1:00 p.m., June 20, 2000
Discussion Leader, Remy Bertrand, IPSN

Topic - Presentations of tasks conducted in national programs for fire modeling (e.g., test results pertinent to the issues under examination). Allotted time for each paper is twenty minutes.

1. Fire Tests Related to Electrical Cables and other Fire Tests in Progress, Jean-Marc Such, IPSN

2. Burning Behavior of Electrical Cables Using Different Experimental Methods, Dietmar Hosser, and Juergen Will, iBMB of TU Braunschweig (presented by Juergen Will)

3. Cable Tunnel Fire Experiments at VTT, Olavi Keski-Rahkonen, VTT

4. Estimation of Probability Distribution of Secondary Target Ignition in a Cable Tunnel, Olavi Keski-Rahkonen, VTT

5. French Fire Modeling of Scenarios Under Nuclear Plant Conditions, Bernard Gautier, Olivier Pages, Maurice Kaercher, EdF

Session 3: Continued 2:30 - 3:15 p.m., June 20, 2000

6. Some Blind Fire Simulations Using CFD, Stewart Miles, BRE/FRS

7. Risk-Informed, Performance-Based Analysis of Turbine-Generator Fires in a Nuclear Power Plant Turbine Building, Moni Dey, NRC

Session 4: Closing Session 3:30 - 5:30 p.m., June 20, 2000
Discussion Leader: Moni Dey, NRC

1. Continue discussion of approaches for collaborating on experimental research for fire model validation and development

2. Comments and suggestions on the use of and improvements for the project web site

3. Discussion of other logistical issues for project coordination

4. Finalize an action plan

Concluding remarks:

Remy Bertrand, IPSN

*Lunches and Coffee Breaks in the morning will be provided courtesy of IPSN*

# Attachment C: View Graphs Used for Comments on Benchmark Exercise, and Description of Fire Codes

# Attachment D: View Graphs Used to Present Fire Modeling Research in National Programs